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Final Drainage Study: Granger Solar

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PROJECT LOCATION & DESCRIPTION

LOCATION

The proposed NLP Granger Solar Project (proposed "Project") site is located in the community of Valley Center, California in north-central San Diego County. The subject site is located at the northeast corner of Mesa Crest Road and Avenida Annalie. The property is located on County Assessor Parcel Number (APN) 129-162-07, approximately 40 acres. A Vicinity Map is included in Appendix A.

DESCRIPTON

The project proposes a 4 million watt (W) photovoltaic (PV) electricity generating facility on approximately 25-acres (of the 40-acre property). The development includes photovoltaic modules mounted on steel structures, a substation, inverter pads and main transformers, electrical equipment, infrastructure improvements, disintegrated granite (DG) driveways, chain link fence, earthen swale, and on-site DG access roads.

Proposed improvements associated with the project will include grading which is not anticipated to have any impact on flow path length, direction, or time; as compared to pre-development conditions. Clearing and grubbing will be required only for proposed foundations and access roads. In addition, a hydroseeding mix will be applied to the site to restore vegetative cover consistent with pre-development conditions. The proposed development will not impose drainage, grading or flooding hazard to itself or surrounding properties.

PROJECT DESIGN CRITERIA

The calculation procedures and standards for stormwater design are based upon standard County of San Diego reference manuals, including:

- San Diego County Hydrology Manual (SDCHM), June 2003
- San Diego County Hydraulic Design Manual (HDM), September 2014
- California Environmental Quality Act's (CEQA) Thresholds of Significance

SCOPE OF REPORT

The objectives of this final drainage study are outlined below:

- Identify pertinent locations and quantify project site run-on (if any) and runoff for the 100-year storm event using the Rational Method,
- Document the hydraulic capacity of three existing culverts; two 18" CMP culverts located along the southerly project boundary and one 12" HDPE culvert along the northwesterly boundary,

- Identify and evaluate potentially erosive conditions due to existing site run-on and/or runoff characteristics,
- Show that the proposed project does not create an impact on the hydrologic and hydraulic properties of the site, as compared to existing conditions,
- Directly address CEQA thresholds of significance.

METHODOLOGY

RATIONAL METHOD HYDOLOGY

Advanced Engineering Software (AES) HydroWIN v. 2013 was used for hydrologic modeling of the project site watershed. Design peak flow rates for the project site were developed based upon the Rational Method methodologies described in the County of San Diego Hydrology Manual (June 2003). The Rational Method is a physically-based model that calculates peak flow rates (Q) as a function of drainage area (A), rainfall intensity (i), and a runoff coefficient (c):

$$Q = c * i * A$$

Runoff Coefficient (c)

On-site runoff coefficients were developed based upon SDCHM Table 3-1. Pre and post-development runoff coefficients were developed using an area-weighted composite runoff coefficient for the project site drainage basin based on land-use, hydrologic soil type, and impervious area. Calculations are included in Attachment B.

The current land is undeveloped, covered in dirt, grass, and brush. Approximately 60% of the parcel will comprise the project area.

The hydrologic soil type classifications were determined using the Natural Resources Conservation Services' Web-Soil Survey. The project site is comprised of Vista Coarse Sandy Loam (hydrologic soil type B – approximately 90%), Placentia Sandy Loam (hydrologic soil type C – approximately 9%), and sliver of Metamorphic Rock Land (hydrologic soil type D – approximately 1%) along the easterly project boundary. The existing and proposed hydrologic analyses account for the differing hydrologic soil types within each drainage sub-basin. Refer to Appendix A for a Soils Exhibit and Appendix B for the existing and proposed weighted runoff coefficients.

Rainfall Intensity (i)

The 100-year, 6-hour precipitation depth, (3.7 inches) and 24-hour precipitation depth (8.1 inches) were obtained from the isopluvial maps found in Appendix B of the SDCHM. Copies are included in Attachment A of this report.

The time of concentration (Tc) for each drainage basin was calculated internally within AES using criteria outlined in the SDCHM.

Drainage Area (A)

On-site drainage area delineations are based upon project specific one-foot contour topography. There are no off-site run-on contributions to the project site. Approximately 16.4-acres drain northwesterly to Node 100, located in the northwest corner of the site. Runoff is discharged from the site, to Mesa Crest Road, as surface flow. Mesa Crest Road is a narrow road with no curb or gutter.

Approximately 7.2-acres drain southerly to Nodes 200 and 300, located along the southerly project boundary (Avenida Annalie). This road also does not contain curb and gutter.

Approximately 1.5-acres drain easterly to Node 400, along the easterly project boundary. Runoff continues to travel east into an undeveloped portion of the property.

HYDRAULICS

There are two existing 18-inch corrugated metal pipe (CMP) culverts located along the southerly project boundary, and a third located near the northwesterly project boundary. The southerly culverts, labeled 'A' and 'B' on the hydrologic work maps, are located adjacent to Drainage Nodes 200 and 300, respectively, and convey project site runoff southerly beneath Avenida Annalie. The northwesterly 12-inch HDPE culvert is labeled 'C' on the hydrologic work maps, is located adjacent to Node 100, and conveys flow westerly beneath Mesa Crest Road.

The existing capacity of each culvert has been determined using Bentley's CulvertMaster. This software accounts for inlet and outlet control using the widely excepted Federal Highway Administration's (FHA) methodology (HEC-18) for culvert capacity determination. All three culverts are assumed to be unclogged for the purposes of determining the capacity prior to roadway overtopping. Project site topography (one-foot contour interval) has been used to determine the slope and allowable headwater at each culvert.

RESULTS

HYDOLOGY

The tables below summarize the hydrologic properties of the project site under existing and proposed conditions. The proposed development, specifically new impervious surfaces, will not result in a calculable increase to the project site runoff coefficient. Approximately 4,742-square feet (0.11 acres) of new impervious area is proposed throughout the 25-acre project (0.44% increase), consisting of one inverter pad and the solar panel support posts. Weighted runoff coefficient calculations are included in Appendix B.

The existing project site is comprised of dirt, grass, and brush. A Manning's Roughness Coefficient of 0.035 was selected for calculating flow, based on the descriptions of cover described in the San Diego County Hydraulic Design Manual (2014) – an excerpt is included in Appendix A.

Only minimal grading is proposed (no compaction, channelization, soil export or import) and there are no physical alterations to the two existing 18-inch CMP culverts, one 12-inch HDPE culvert, or newly proposed storm drain improvements proposed with this project; therefore, the post-development time of concentration will remain substantially unchanged from the pre-development condition.

Refer to Appendix B for hydrologic work maps and AES output.

100-YEAR EXISTING HYDROLOGIC SUMMARY

Node	Tc	c	i	Total Area	Total Q100	V100
-	min	-	in/hr	acres	cfs	ft/sec
140	8.42	0.25	7.0	0.12	0.21	-
130	15.45	0.25	4.7	3.16	3.72	1.16
100	25.19	0.26	3.4	16.35	14.50	1.41
240	6.12	0.25	8.6	0.32	0.68	-
230	7.08	0.25	7.8	1.11	2.16	1.39
200	10.01	0.25	6.23	3.66	5.70	1.82
340	7.71	0.25	7.4	0.17	0.31	-
330	9.92	0.25	6.27	0.57	0.89	0.80
300	13.58	0.25	5.12	3.50	4.48	1.23
400	5.00	0.26	9.75	1.49	3.80	-
Refer to the Hydrologic Work Maps and AES output found in Appendix B						

100-YEAR PROPOSED HYDROLOGIC SUMMARY

Node	Tc	C (weighted)	i	Total Area	Total Q100	V100
-	min	-	in/hr	acres	cfs	ft/sec
140	8.42	0.25	7.0	0.12	0.21	-
130	15.45	0.25	4.7	3.16	3.72	1.16
100	25.19	0.26	3.4	16.35	14.50	1.41
240	6.12	0.25	8.6	0.32	0.68	-
230	7.08	0.25	7.8	1.11	2.16	1.39
200	10.01	0.25	6.23	3.66	5.70	1.82
340	7.71	0.25	7.4	0.17	0.31	-
330	9.92	0.25	6.27	0.57	0.89	0.80
300	13.58	0.25	5.12	3.50	4.48	1.23
400	5.00	0.26	9.75	1.49	3.80	-
Refer to the Hydrologic Work Maps and AES output found in Appendix B						

RUNOFF COEFFICIENTS SUMMARY

Node	Existing Condition Sub-Area	Proposed Condition Sub-Area	Existing Runoff Coefficient	Proposed Runoff Coefficient
-	acres	acres	-	-
140	0.12	0.12	0.25	0.25
130	3.04	3.04	0.25	0.25
100	13.19	13.19	0.26	0.26
240	0.32	0.32	0.25	0.25
230	0.79	0.79	0.25	0.25
200	2.55	2.55	0.25	0.25
340	0.40	0.40	0.25	0.25
330	2.93	2.93	0.25	0.25
300	2.93	2.93	0.25	0.25
400	1.49	1.49	0.26	0.26
The proposed improvements will not result in a calculable change to on-site runoff coefficients – refer to the weighted runoff coefficient calculations found in Appendix B.				

HYDRAULICS

Proposed improvements will not result in an increase of runoff to the three existing culverts, nor will any new culverts be installed. As such, the hydraulic properties of the existing culverts will not be altered as a result of the proposed development. See Appendix C for CulvertMaster input and output.

HYDRAULIC SUMMARY

18-Inch CMP Identifier	Node	Slope	Allowable Head Water	Capacity (prior to overtopping)	Q100	V100 (exit velocity)
-	-	%	ft	cfs	cfs	ft/sec
A	200	13	11	24.3	5.7	14.73
B	300	9	8	19.8	4.5	14.73
C	100	50	4	6.0	14.5	33.10
Refer to Appendix C for Culvert Master Input and Output						

CONCLUSIONS

The following are conclusions and design recommendations based upon the analysis presented in this report and its Attachments.

- The Rational Method has been used to calculate the 100-year peak flow rate at all project site runoff boundaries. There are no sources of project site run-on from off-site area. The proposed improvements will not result in an increase peak flow discharge from the project site, as compared to pre-development conditions. Refer to the Hydrologic Work Maps and AES output found in Attachment B.

- The existing culverts along the southerly boundary (A and B) are adequately sized to convey the 100-year event prior to overtopping the roadway, under as-built conditions (i.e. not clogged). The existing culvert in the northwest corner (C) is not adequately sized to convey the 100-year event. The capacity, prior to overtopping, has been documented within this report, based on the as-built condition (i.e. unclogged). Refer to Attachment C for hydraulic calculations.

  Culverts A and B are approximately 50- and 75-percent clogged, respectively. These culverts (A and B) are located off-site within a private road easement. Further coordination between the County, NLP Granger A82, LLC, and Michael Baker International will be required for on-site construction activities to include cleaning these off-site culverts. Culvert C is approximately 100-percent clogged and is located on-site. As such, this culvert will either be cleaned or replaced in kind as part of the planned construction.

- A non-toxic, biodegradable, permeable soil-binding agent or permeable rock material will be applied to all disturbed or exposed surface areas as follows: a) A permeable soil-binding agent suitable for both traffic and non-traffic areas shall be used. These agents shall be biodegradable, eco-safe, with liquid copolymers that stabilize and solidify soils or aggregates and facilitate dust suppression; or, b) alternatively, a permeable rock material consisting of either river stone decomposed granite or gravel could be placed in a thin cover over all exposed surface area in-lieu of the binding agent referenced above. In-lieu of, or in combination with a) and b) above, the areas located between the arrays, and any non-drivable surface may be re-vegetated with native noninvasive plant species.

- Based on the size of the project site (25 acres), and the minimal amount of proposed impervious area (0.11 acres), the increase to the on-site post development composite runoff coefficient is less than 0.01. Proposed improvements associated with the project will require grading; however, no change to the direction or quantity of storm water runoff will occur, as compared to predevelopment conditions. Minimal clearing and grubbing will be required to install the proposed solar panels. No export or import of soil is proposed; therefore, the project site drainage areas will not be changed, as compared to existing conditions. As such, there is no anticipated increase in project site peak flow runoff. Peak flow attenuation design is considered unwarranted.

- Refer to the following pages for the CEQA thresholds of significance.

CEQA GUIDELINES FOR DETERMINING SIGNIFICANCE

1. **Will the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?**

   The project will not alter the existing drainage pattern across the site. Upon completion of the project, runoff will continue to flow northwesterly towards Mesa Crest Road and southerly towards Avenida Annalie. A small portion of the site will continue to drain easterly, consistent with pre development conditions. As runoff sheet flows off the solar panels, the permeable soil binder will prevent significant erosive and allow runoff to continue in a sheet flow manner off-site.

2. **Will the project increase water surface elevation in a watercourse within a watershed equal to or greater than 1 square mile, by 1 foot or more in height and in the case of the San Luis Rey River, San Dieguito River, San Diego River, Sweetwater River and Otay River, 2/10 of a foot or more?**

   The project will not increase water surface elevations across the site or downstream. Proposed improvements will not alter the existing hydrologic and hydraulic properties of the site. No increase in peak flow discharge is anticipated as a result of the proposed project.

3. **Will the project result in increased velocities and peak flow rates exiting the project site that could cause flooding downstream or exceed the storm water drainage system capacity serving the site?**

   The project will not increase runoff velocities or peak flow rates leaving the site. Runoff will continue to flow as it does under existing conditions. The project will not cause flooding downstream, nor will it hydraulically impact downstream storm water infrastructure.

4. **Will the project result in placing housing, habitable structures, or unanchored impediments to flow in a 100-year floodplain area or other special flood hazard area, as shown on a FIRM, a County Flood Plain Map or County Alluvial Fan Map, which would subsequently endanger health, safety and property due to flooding?**

   There are no proposed habitable structures as part of the project. The project site is mapped as Un-Shaded Zone X on the FEMA Flood Insurance Rate Map (FIRM) and does not contain a tributary watershed over 25 acres (County standard for 100-year limits of inundation determination). A topographic ridgeline forms the easterly project boundary, and directs storm water runoff westerly. As such, the project site is not subjected to run-on from off-site area.

5. **Will the project place structures within a 100-year flood hazard or alter the floodway in a manner that would redirect or impede flow resulting in any of the following:**

a) Alter the line of inundation resulting in the placement of other housing in a 100 year flood hazard

b) Increase water surface elevation in a watercourse with a watershed equal to or greater than 1 square mile by 1 foot or more in height and in the case of the San Luis Rey River, San Dieguito River, San Diego River, Sweetwater River and Otay River, 2/10 of a foot or more?

The entire proposed development will be located outside the 100-year limit of inundation.

The project will not increase water surface elevations across the site or downstream. Proposed improvements will not alter the existing hydrologic and hydraulic properties of the site. No increase in peak flow discharge, as compared to pre development conditions, is anticipated as a result of the proposed project.

REFERENCES

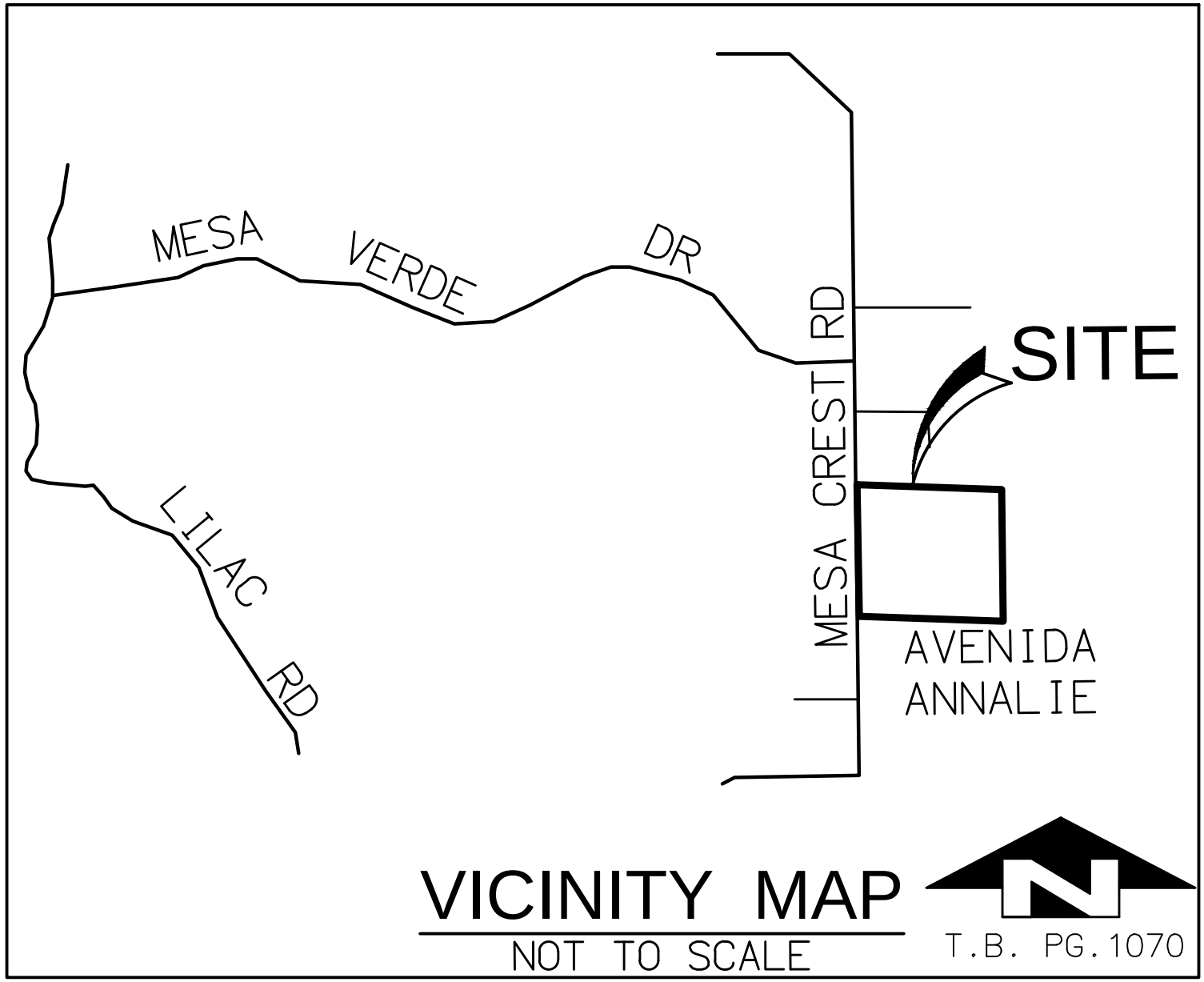
County, S. D. (June 2003). *San Diego County Hydrology Manual.*

County, S. D. (September 2014). *San Diego County Hydraulic Design Manual.*

Appendix A: Watershed Information

Vicinity Map
Aerial Exhibit
FEMA FIRM
Soil Exhibit
100-YR, 6-HR & 24-HR Isopluvials
Manning's Roughness Coefficient

Michael Baker
INTERNATIONAL



VICINITY MAP

NOT TO SCALE

T.B. PG. 1070

AERIAL MAP

MAP SCALE 1" = 1000'

0 500 1,000 1,500 2,000 FEET

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0520G

FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 520 OF 2375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN DIEGO COUNTY	060284	0520	G

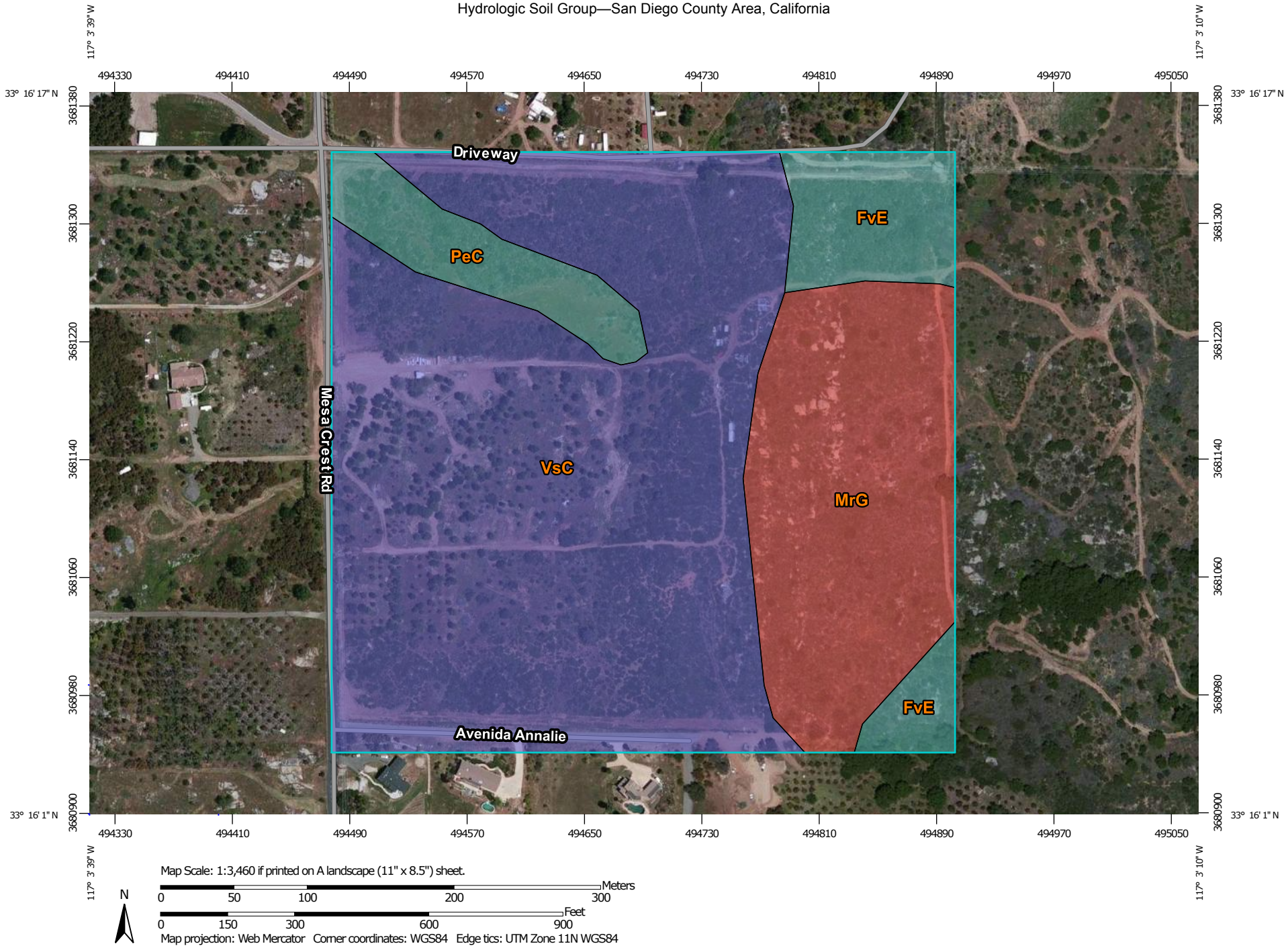
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06073C0520G

MAP REVISED
MAY 16, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov


117° 3' 39" W
117° 3' 10" W
494330
494410
494490
494570
494650
494730
494810
494890
494970
495050
33° 16' 17" N
33° 16' 1" N
3681380
3681300
3681220
3681140
3681060
3680980
3680900
Driveway
Mesa Crest Rd
Avenida Annalie
PeC
FvE
VsC
MrG
FvE
Map Scale: 1:3,460 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 50 100 200 300
Feet
0 150 300 600 900
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 8, Sep 17, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 2, 2010—Jun 19, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — San Diego County Area, California (CA638)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
FvE	Fallbrook-Vista sandy loams, 15 to 30 percent slopes	C	3.4	7.9%
MrG	Metamorphic rock land	D	9.6	22.4%
PeC	Placentia sandy loam, 2 to 9 percent slopes, warm MAAT, MLRA 19	C	2.6	6.0%
VsC	Vista coarse sandy loam, 5 to 9 percent slopes	B	27.4	63.8%
Totals for Area of Interest			**43.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

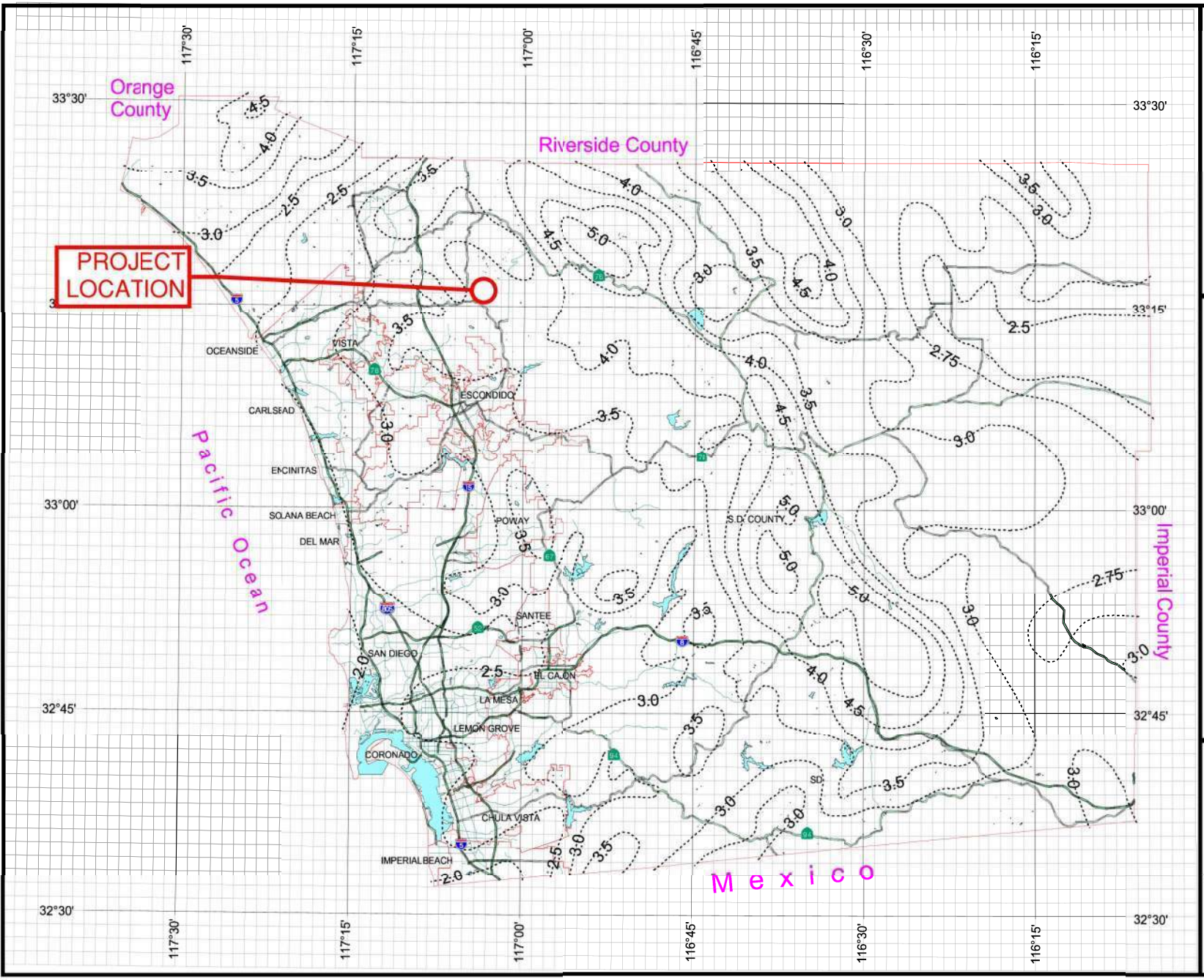
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

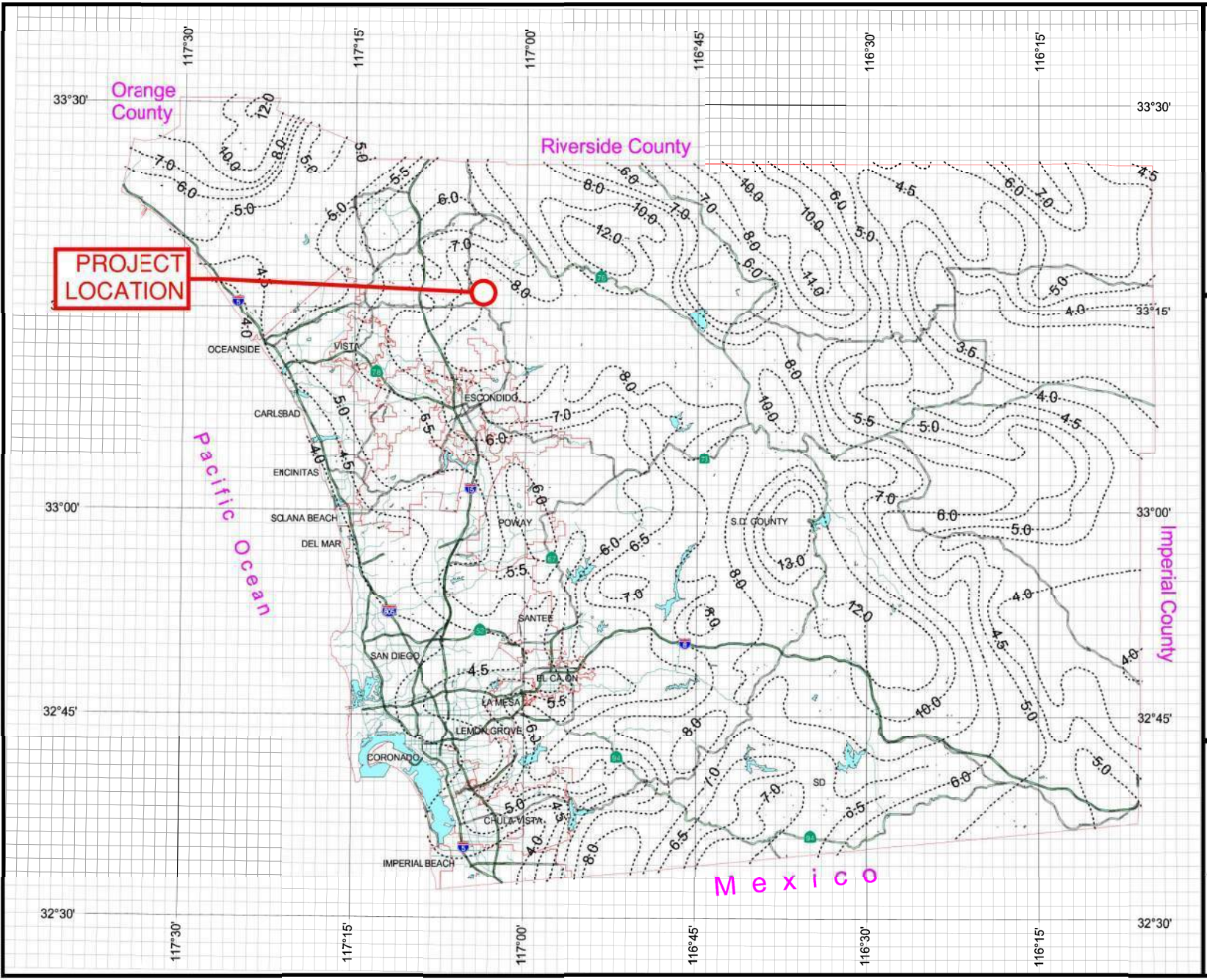
P(6)100=3.7

DPW GIS
Department of Public Works Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

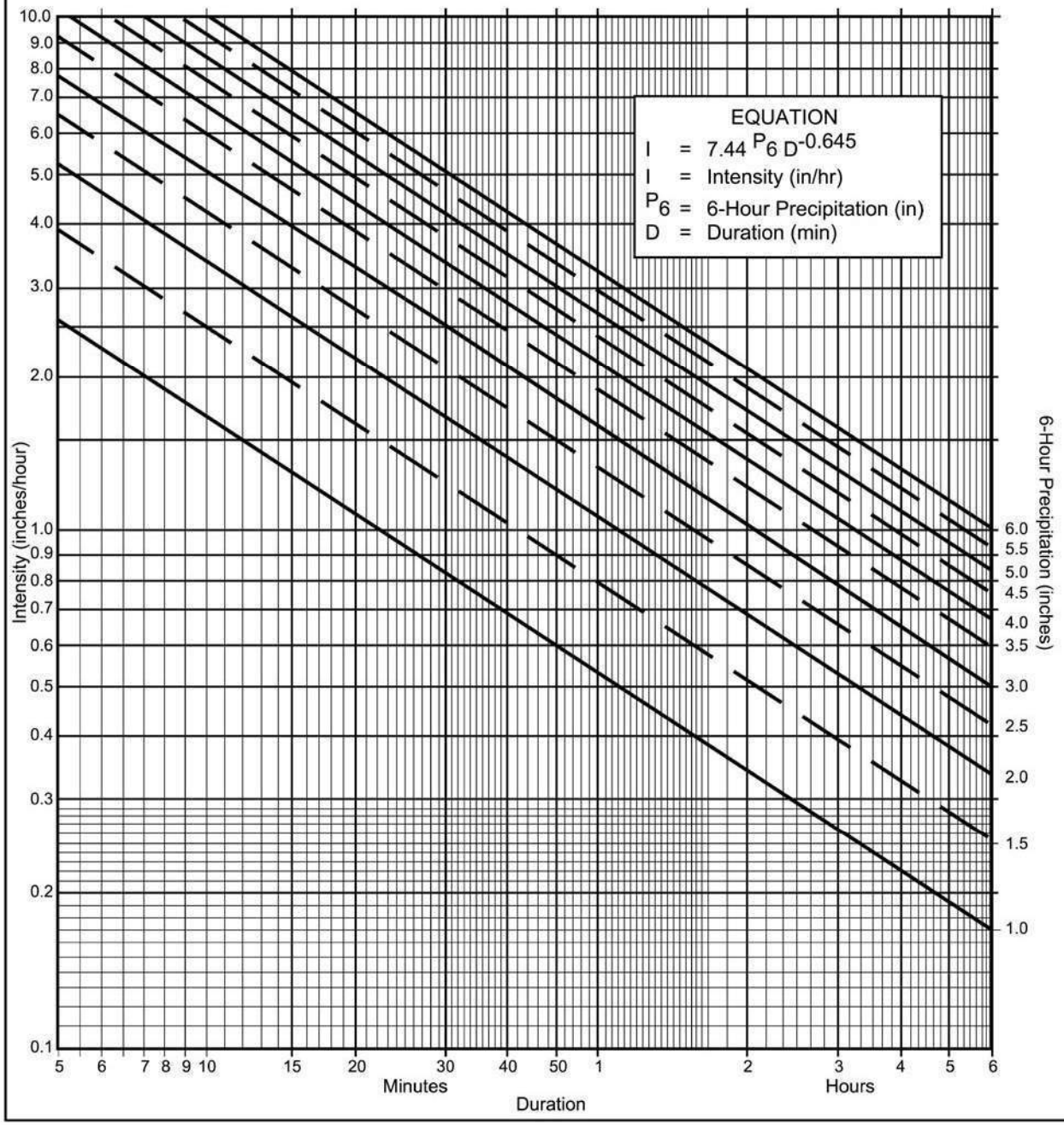
P(24)100=8.1

DPW GIS
Department of Public Works Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 3.7 in., P_{24} = 8.1, $\frac{P_6}{P_{24}}$ = 46 %(2)

(c) Adjusted P_6(2) = * in.

(d) t_x = * min.

(e) I = * in./hr.

*REFER TO AES OUTPUTS (APPENDIX B)

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1

Table A-5 Average Manning Roughness Coefficients for Natural Channels

Minor Streams (Surface Width at Flood Stage < 100 ft)

Fairly Regular Section

SITE IS BOTH (A) AND (B)

- (A) Some Grass and Weeds, Little or No Brush 0.030
- (B) Dense Growth of Weeds, Depth of Flow Materially Greater Than Weed Height 0.040

USE 0.035

- (C) Some Weeds, Light Brush on Banks 0.040
- (D) Some Weeds, Heavy Brush on Banks 0.060
- (E) For Trees within Channel with Branches Submerged at High Stage, Increase All Above Values By 0.015

Irregular Section, with Pools, Slight Channel Meander

- Channels (A) to (E) Above, Increase All Values By 0.015

Mountain Streams; No Vegetation in Channel, Banks Usually Steep, Trees and Brush along Banks Submerged at High Stage

- (A) Bottom, Gravel, Cobbles and Few Boulders 0.050
- (B) Bottom, Cobbles with Large Boulders 0.060

Flood Plains (Adjacent To Natural Streams)

Pasture, No Brush

- (A) Short Grass 0.030
- (B) High Grass 0.040

Cultivated Areas

- (A) No Crop 0.040
- (B) Mature Row Crops 0.040
- (C) Mature Field Crops 0.050

Heavy Weeds, Scattered Brush 0.050

Light Brush and Trees 0.060

Medium To Dense Brush 0.090

Dense Willows 0.170

Cleared Land with Tree Stumps, 100-150 Per Acre 0.060

Heavy Stand of Timber, Little Undergrowth

- (A) Flood Depth below Branches 0.110
- (B) Flood Depth Reaches Branches 0.140

Appendix B: Hydrologic Calculations

Weighted Runoff Coefficient
Existing Condition Work Map
Existing Condition AES
Proposed Condition Work Map
Proposed Condition AES

Michael Baker
INTERNATIONAL

Total proposed impervious area is 4,742 square feet (0.11 acres): solar support posts and invertor pad

ON-SITE Runoff Coefficients

EXISTING Condition

Land Use	Node 140	
	Area	C
Type B Natural	0.12	0.25
EX. Impervious	0.00	0.90
Total	**0.12**	

Weighted C = 0.25

Land Use	Node 130	
	Area	C
Type B Natural	3.04	0.25
EX. Impervious	0.00	0.90
Total	**3.04**	

Weighted C = 0.25

Land Use	Node 100	
	Area	C
Type B Natural	10.91	0.25
Type C Natural	2.28	0.30
EX. Impervious	0.00	0.90
Total	**13.19**	

Weighted C = 0.26

Land Use	Nodes 250 to 200	
	Area	C
Type B Natural	3.66	0.25
EX. Impervious (pavement)	0.00	0.90
Total	**3.66**	

Weighted C = 0.25

Land Use	Nodes 350 to 300	
	Area	C
Type B Natural	3.50	0.25
EX. Impervious (pavement)	0.00	0.90
Total	**3.50**	

Weighted C = 0.25

PROPOSED Condition

Land Use	Node 140	
	Area	C
Type B Natural	0.1195	0.25
EX. Impervious	0.000	0.90
Impervious (solar panel posts & inverter pad)	0.0005	0.90
Total	**0.12**	

Weighted C = 0.25

Land Use	Node 130	
	Area	C
Type B Natural	3.03	0.25
EX. Impervious	0.00	0.90
Impervious (solar panel posts & inverter pad)	0.01	0.90
Total	**3.04**	

Weighted C = 0.25

Land Use	Node 100	
	Area	C
Type B Natural	10.85	0.25
Type C Natural	2.28	0.30
EX. Impervious	0.00	0.90
Impervious (solar panel posts & inverter pad)	0.06	0.90
Total	**13.19**	

Weighted C = 0.26

Land Use	Nodes 250 to 200	
	Area	C
Type B Natural	3.64	0.25
EX. Impervious (pavement)	0.00	0.90
Impervious (solar panel posts & 4 inverter pads)	0.02	0.90
Total	**3.66**	

Weighted C = 0.25

Land Use	Nodes 350 to 300	
	Area	C
Type B Natural	3.48	0.25
EX. Impervious (pavement)	0.00	0.90
Impervious (solar panel posts & inverter pad)	0.02	0.90
Total	**3.50**	

Weighted C = 0.25

Land Use	Node 400	
	Area	C
Type B Natural	1.29	0.25
Type D Natural	0.20	0.35
EX. Impervious (pavement)	0.00	0.90
Total	**1.49**	

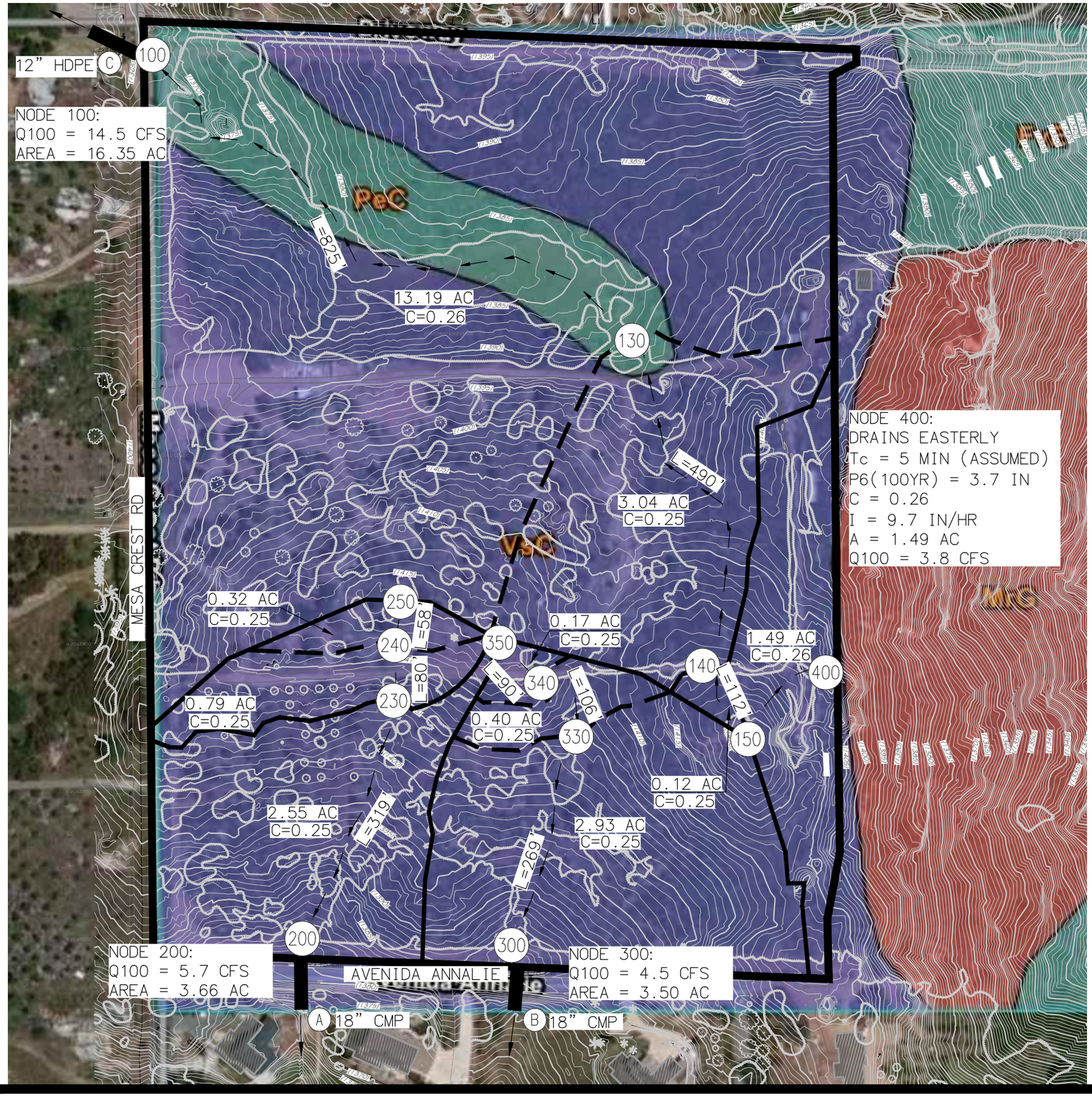
Weighted C = 0.26

Land Use	Node 400	
	Area	C
Type B Natural	1.290	0.25
Type D Natural	0.196	0.35
EX. Impervious (pavement)	0.00	0.90
Impervious (solar panel posts & inverter pad)	0.004	0.90
Total	**1.49**	

Weighted C = 0.26

Total Area =	**25.00**	**ac**
Total Impervious =	**0.00**	**ac**

Total Area =	**25.00**	**ac**
Total Impervious =	**0.11**	**ac**



LEGEND

- 100 — DRAINAGE NODE
- PROJECT BOUNDARY
- DRAINAGE BASIN
- DRAINAGE SUBBASIN
- FLOW PATH
- A — EXISTING CULVERT
- DRAINAGE DIRECTION

VsC = VISTA COARSE SANDY LOAM
HYDROLOGIC SOIL TYPE B

PeC = PLACENTIA SANDY LOAM
HYDROLOGIC SOIL TYPE C

MrG = METAMORPHIC ROCK LAND
HYDROLOGIC SOIL TYPE D

DRAINAGE NODE	ELEV (FT)
150	1,421
140	1,415
130	1,389
100	1,366
250	1,416
240	1,412
230	1,405
200	1,381

DRAINAGE NODE	ELEV (FT)
350	1,416
340	1,410
330	1,405
300	1,385

SCALE: 1"=150'

150 75 0 150 300 450

SCALE: 1"=150'

BAYWA r.e GRANGER
SOLAR VALLEY CENTER
EXISTING HYDROLOGIC WORK MAP - 100YR

RBF CONSULTING
PLANNING ■ DESIGN ■ CONSTRUCTION
9755 CLAIREMONT MESA BOULEVARD, SUITE 100
SAN DIEGO, CALIFORNIA 92124-1324
858.614.5000 ■ FAX 858.614.5001 ■ www.RBF.com

\\SANDCA1FS1\HROOT\PDATA\145597\CADD\STRMWATER\EXHIBITS\EX WORK MAP.DWG CHOY, DARREN 9/10/2015 2:52 PM

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**************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2013 Advanced Engineering Software (aes)
              Ver. 20.0 Release Date: 06/01/2013  License ID 1264

                              Analysis prepared by:

                                  RBF Consulting
                                14257 Alton Parkway
                                     Irvine, CA
                                       92618

 ************************** DESCRIPTION OF STUDY **************************
* GRANGER SOLAR                                                          *
* EXISTING CONDITION                                                     *
* 100 YEAR HYDROLOGY ANALYSIS                                            *
 **************************************************************************

  FILE NAME: BGS100EX.DAT
  TIME/DATE OF STUDY: 16:14 05/13/2015
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  36.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

**************************************************************************
  FLOW PROCESS FROM NODE    150.00 TO NODE    140.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =   1421.00
  DOWNSTREAM ELEVATION(FEET) =   1415.00
  ELEVATION DIFFERENCE(FEET) =      6.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    8.420
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.965
```

```
  SUBAREA RUNOFF(CFS) =      0.21
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.21

****************************************************************************
  FLOW PROCESS FROM NODE    140.00 TO NODE    130.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1415.00  DOWNSTREAM(FEET) =   1389.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   490.00   CHANNEL SLOPE =  0.0531
  CHANNEL BASE(FEET) =   50.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.709
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.06
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.16
  AVERAGE FLOW DEPTH(FEET) =   0.04   TRAVEL TIME(MIN.) =   7.03
  Tc(MIN.) =   15.45
  SUBAREA AREA(ACRES) =     3.04       SUBAREA RUNOFF(CFS) =    3.58
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.250
  TOTAL AREA(ACRES) =        3.2         PEAK FLOW RATE(CFS) =       3.72

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.06   FLOW VELOCITY(FEET/SEC.) =   1.31
  LONGEST FLOWPATH FROM NODE    150.00 TO NODE    130.00 =     590.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1389.00  DOWNSTREAM(FEET) =   1366.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   825.00   CHANNEL SLOPE =  0.0279
  CHANNEL BASE(FEET) =   70.00   "Z" FACTOR =  30.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.436
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2600
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.71
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.41
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   9.74
  Tc(MIN.) =   25.19
  SUBAREA AREA(ACRES) =    13.19       SUBAREA RUNOFF(CFS) =   11.78
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.258
  TOTAL AREA(ACRES) =       16.3         PEAK FLOW RATE(CFS) =      14.50

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.12   FLOW VELOCITY(FEET/SEC.) =   1.65
  LONGEST FLOWPATH FROM NODE    150.00 TO NODE    100.00 =    1415.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    250.00 TO NODE    240.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
```

```
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    58.00
  UPSTREAM ELEVATION(FEET) =   1416.00
  DOWNSTREAM ELEVATION(FEET) =   1412.00
  ELEVATION DIFFERENCE(FEET) =      4.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.122
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.555
  SUBAREA RUNOFF(CFS) =      0.68
  TOTAL AREA(ACRES) =      0.32   TOTAL RUNOFF(CFS) =      0.68

****************************************************************************
  FLOW PROCESS FROM NODE    240.00 TO NODE    230.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1412.00  DOWNSTREAM(FEET) =   1405.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    80.00   CHANNEL SLOPE =  0.0875
  CHANNEL BASE(FEET) =   25.00   "Z" FACTOR =  15.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.787
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.46
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.39
  AVERAGE FLOW DEPTH(FEET) =   0.04   TRAVEL TIME(MIN.) =   0.96
  Tc(MIN.) =    7.08
  SUBAREA AREA(ACRES) =     0.79       SUBAREA RUNOFF(CFS) =    1.54
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.250
  TOTAL AREA(ACRES) =        1.1         PEAK FLOW RATE(CFS) =       2.16

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.05   FLOW VELOCITY(FEET/SEC.) =   1.66
  LONGEST FLOWPATH FROM NODE    250.00 TO NODE    230.00 =     138.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    230.00 TO NODE    200.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1405.00  DOWNSTREAM(FEET) =   1381.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   319.00   CHANNEL SLOPE =  0.0752
  CHANNEL BASE(FEET) =   35.00   "Z" FACTOR =  15.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.230
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.17
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.82
  AVERAGE FLOW DEPTH(FEET) =   0.06   TRAVEL TIME(MIN.) =   2.93
  Tc(MIN.) =   10.01
  SUBAREA AREA(ACRES) =     2.55       SUBAREA RUNOFF(CFS) =    3.97
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.250
  TOTAL AREA(ACRES) =        3.7         PEAK FLOW RATE(CFS) =       5.70

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.08   FLOW VELOCITY(FEET/SEC.) =   1.99
  LONGEST FLOWPATH FROM NODE    250.00 TO NODE    200.00 =     457.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    350.00 TO NODE    340.00 IS CODE =  21
```

```
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==============================================================================
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    90.00
  UPSTREAM ELEVATION(FEET) =   1416.00
  DOWNSTREAM ELEVATION(FEET) =   1410.00
  ELEVATION DIFFERENCE(FEET) =      6.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.713
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.371
  SUBAREA RUNOFF(CFS) =      0.31
  TOTAL AREA(ACRES) =      0.17   TOTAL RUNOFF(CFS) =      0.31

****************************************************************************
  FLOW PROCESS FROM NODE    340.00 TO NODE    330.00 IS CODE =  51
------------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1410.00  DOWNSTREAM(FEET) =   1405.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   106.00   CHANNEL SLOPE =  0.0472
  CHANNEL BASE(FEET) =   30.00   "Z" FACTOR =  18.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.265
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.63
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.80
  AVERAGE FLOW DEPTH(FEET) =   0.03   TRAVEL TIME(MIN.) =   2.21
  Tc(MIN.) =    9.92
  SUBAREA AREA(ACRES) =     0.40       SUBAREA RUNOFF(CFS) =    0.63
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.250
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       0.89

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.03   FLOW VELOCITY(FEET/SEC.) =   0.87
  LONGEST FLOWPATH FROM NODE    350.00 TO NODE    330.00 =     196.00 FEET.

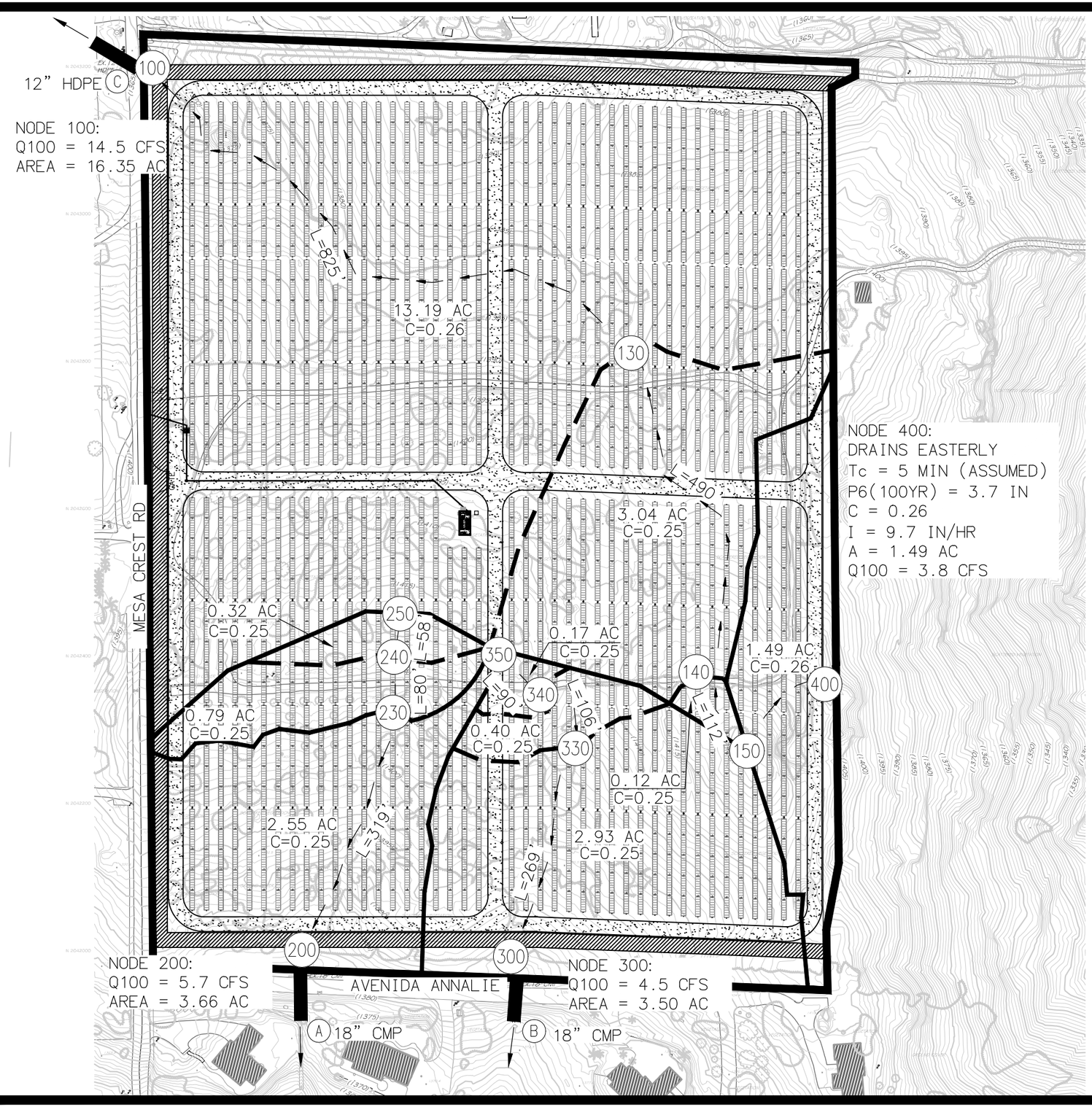
****************************************************************************
  FLOW PROCESS FROM NODE    330.00 TO NODE    300.00 IS CODE =  51
------------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1405.00  DOWNSTREAM(FEET) =   1385.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   269.00   CHANNEL SLOPE =  0.0743
  CHANNEL BASE(FEET) =   55.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.118
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.81
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.23
  AVERAGE FLOW DEPTH(FEET) =   0.04   TRAVEL TIME(MIN.) =   3.66
  Tc(MIN.) =   13.58
  SUBAREA AREA(ACRES) =     2.93       SUBAREA RUNOFF(CFS) =    3.75
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.250
  TOTAL AREA(ACRES) =        3.5         PEAK FLOW RATE(CFS) =       4.48
```

```
  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.05   FLOW VELOCITY(FEET/SEC.) =   1.58
  LONGEST FLOWPATH FROM NODE    350.00 TO NODE    300.00 =     465.00 FEET.

+----------------------------------------------------------------------------+
| NODE 150 TO NODE 400 ASSUMES TC                                            |
| RUNOFF FLOWS EAST (OFF SITE)                                               |
| SEE EXISTING HYDROLOGIC WORK MAP FOR FULL CALCULATION                      |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    150.00 TO NODE    400.00 IS CODE =  16
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED CONSTANT SOURCE FLOW AT NODE<<<<<
============================================================================
  USER-SPECIFIED CONSTANT SOURCE FLOW =     3.80(CFS)
  USER-SPECIFIED AREA ASSOCIATED TO SOURCE FLOW =     1.46(ACRES)
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =     3.80  AREA(AC.) =     1.46
  * SUMMED DATA: FLOW(CFS) =     8.28    TOTAL AREA(ACRES) =     4.96
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.5  TC(MIN.) =     13.58
  PEAK FLOW RATE(CFS)   =       4.48
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =       3.80  AREA(AC.) =        1.5
  * SUMMED DATA: FLOW(CFS) =       8.28    TOTAL AREA(ACRES) =        5.0
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

♀



LEGEND

- 100 — DRAINAGE NODE
- PROJECT BOUNDARY
- DRAINAGE BASIN
- DRAINAGE SUBBASIN
- FLOW PATH
- A — EXISTING CULVERT
- DRAINAGE DIRECTION

VsC = VISTA COARSE SANDY LOAM
HYDROLOGIC SOIL TYPE B

PeC = PLACENTIA SANDY LOAM
HYDROLOGIC SOIL TYPE C

MrG = METAMORPHIC ROCK LAND
HYDROLOGIC SOIL TYPE D

DRAINAGE NODE	ELEV (FT)
150	1,421
140	1,415
130	1,389
100	1,366
250	1,416
240	1,412
230	1,405
200	1,381

DRAINAGE NODE	ELEV (FT)
350	1,416
340	1,410
330	1,405
300	1,385

SCALE: 1"=150'

150 75 0 150 300 450

SCALE: 1"=150'

BAYWA r.e GRANGER
SOLAR VALLEY CENTER
PROPOSED HYDROLOGIC WORK MAP - 100YR

RBF CONSULTING
PLANNING ■ DESIGN ■ CONSTRUCTION
9755 CLAIREMONT MESA BOULEVARD, SUITE 100
SAN DIEGO, CALIFORNIA 92124-1324
858.614.5000 ▪ FAX 858.614.5001 ▪ www.RBF.com

\\SANDCA1FS1\HROOT\PDATA\145597\CADD\STRMWATER\EXHIBITS\PR WORK MAP.DWG 9/10/2015 2:44 PM CHOY, DARREN

```
**************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2013 Advanced Engineering Software (aes)
              Ver. 20.0 Release Date: 06/01/2013  License ID 1264

                              Analysis prepared by:

                                  RBF Consulting
                                14257 Alton Parkway
                                     Irvine, CA
                                       92618

 ************************** DESCRIPTION OF STUDY **************************
* GRANGER SOLAR                                                          *
* PROPOSED CONDITION                                                     *
* 100 YEAR HYDROLOGY ANALYSIS                                            *
 **************************************************************************

  FILE NAME: BGS100PR.DAT
  TIME/DATE OF STUDY: 16:15 05/13/2015
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  36.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

**************************************************************************
  FLOW PROCESS FROM NODE    150.00 TO NODE    140.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =   1421.00
  DOWNSTREAM ELEVATION(FEET) =   1415.00
  ELEVATION DIFFERENCE(FEET) =      6.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    8.420
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.965
```

```
  SUBAREA RUNOFF(CFS) =      0.21
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.21

****************************************************************************
  FLOW PROCESS FROM NODE    140.00 TO NODE    130.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1415.00  DOWNSTREAM(FEET) =   1389.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   490.00   CHANNEL SLOPE =  0.0531
  CHANNEL BASE(FEET) =   50.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.709
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.06
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.16
  AVERAGE FLOW DEPTH(FEET) =   0.04   TRAVEL TIME(MIN.) =   7.03
  Tc(MIN.) =   15.45
  SUBAREA AREA(ACRES) =     3.04       SUBAREA RUNOFF(CFS) =    3.58
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.250
  TOTAL AREA(ACRES) =        3.2         PEAK FLOW RATE(CFS) =       3.72

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.06   FLOW VELOCITY(FEET/SEC.) =   1.31
  LONGEST FLOWPATH FROM NODE    150.00 TO NODE    130.00 =     590.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1389.00  DOWNSTREAM(FEET) =   1366.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   825.00   CHANNEL SLOPE =  0.0279
  CHANNEL BASE(FEET) =   70.00   "Z" FACTOR =  30.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.436
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2600
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.71
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.41
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   9.74
  Tc(MIN.) =   25.19
  SUBAREA AREA(ACRES) =    13.19       SUBAREA RUNOFF(CFS) =   11.78
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.258
  TOTAL AREA(ACRES) =       16.3         PEAK FLOW RATE(CFS) =      14.50

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.12   FLOW VELOCITY(FEET/SEC.) =   1.65
  LONGEST FLOWPATH FROM NODE    150.00 TO NODE    100.00 =    1415.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    250.00 TO NODE    240.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
```

```
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    58.00
  UPSTREAM ELEVATION(FEET) =   1416.00
  DOWNSTREAM ELEVATION(FEET) =   1412.00
  ELEVATION DIFFERENCE(FEET) =      4.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.122
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.555
  SUBAREA RUNOFF(CFS) =      0.68
  TOTAL AREA(ACRES) =      0.32   TOTAL RUNOFF(CFS) =      0.68

****************************************************************************
  FLOW PROCESS FROM NODE    240.00 TO NODE    230.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1412.00  DOWNSTREAM(FEET) =   1405.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    80.00   CHANNEL SLOPE =  0.0875
  CHANNEL BASE(FEET) =   25.00   "Z" FACTOR =  15.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.787
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.46
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.39
  AVERAGE FLOW DEPTH(FEET) =   0.04   TRAVEL TIME(MIN.) =   0.96
  Tc(MIN.) =    7.08
  SUBAREA AREA(ACRES) =     0.79       SUBAREA RUNOFF(CFS) =    1.54
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.250
  TOTAL AREA(ACRES) =        1.1         PEAK FLOW RATE(CFS) =       2.16

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.05   FLOW VELOCITY(FEET/SEC.) =   1.66
  LONGEST FLOWPATH FROM NODE    250.00 TO NODE    230.00 =     138.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    230.00 TO NODE    200.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1405.00  DOWNSTREAM(FEET) =   1381.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   319.00   CHANNEL SLOPE =  0.0752
  CHANNEL BASE(FEET) =   35.00   "Z" FACTOR =  15.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.230
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.17
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.82
  AVERAGE FLOW DEPTH(FEET) =   0.06   TRAVEL TIME(MIN.) =   2.93
  Tc(MIN.) =   10.01
  SUBAREA AREA(ACRES) =     2.55       SUBAREA RUNOFF(CFS) =    3.97
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.250
  TOTAL AREA(ACRES) =        3.7         PEAK FLOW RATE(CFS) =       5.70

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.08   FLOW VELOCITY(FEET/SEC.) =   1.99
  LONGEST FLOWPATH FROM NODE    250.00 TO NODE    200.00 =     457.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    350.00 TO NODE    340.00 IS CODE =  21
```

```
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
========================================================================
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    90.00
  UPSTREAM ELEVATION(FEET) =   1416.00
  DOWNSTREAM ELEVATION(FEET) =   1410.00
  ELEVATION DIFFERENCE(FEET) =      6.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.713
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.371
  SUBAREA RUNOFF(CFS) =      0.31
  TOTAL AREA(ACRES) =      0.17   TOTAL RUNOFF(CFS) =      0.31

************************************************************************
  FLOW PROCESS FROM NODE    340.00 TO NODE    330.00 IS CODE =  51
------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1410.00  DOWNSTREAM(FEET) =   1405.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   106.00   CHANNEL SLOPE =  0.0472
  CHANNEL BASE(FEET) =   30.00   "Z" FACTOR =  18.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.265
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.63
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.80
  AVERAGE FLOW DEPTH(FEET) =   0.03   TRAVEL TIME(MIN.) =   2.21
  Tc(MIN.) =    9.92
  SUBAREA AREA(ACRES) =     0.40       SUBAREA RUNOFF(CFS) =    0.63
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.250
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       0.89

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.03   FLOW VELOCITY(FEET/SEC.) =   0.87
  LONGEST FLOWPATH FROM NODE    350.00 TO NODE    330.00 =     196.00 FEET.

************************************************************************
  FLOW PROCESS FROM NODE    330.00 TO NODE    300.00 IS CODE =  51
------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1405.00  DOWNSTREAM(FEET) =   1385.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   269.00   CHANNEL SLOPE =  0.0743
  CHANNEL BASE(FEET) =   55.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.118
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .2500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.81
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.23
  AVERAGE FLOW DEPTH(FEET) =   0.04   TRAVEL TIME(MIN.) =   3.66
  Tc(MIN.) =   13.58
  SUBAREA AREA(ACRES) =     2.93       SUBAREA RUNOFF(CFS) =    3.75
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.250
  TOTAL AREA(ACRES) =        3.5         PEAK FLOW RATE(CFS) =       4.48
```

```
  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.05   FLOW VELOCITY(FEET/SEC.) =   1.58
  LONGEST FLOWPATH FROM NODE    350.00 TO NODE    300.00 =     465.00 FEET.

+----------------------------------------------------------------------------+
| NODE 150 TO NODE 400 ASSUMES TC                                            |
| RUNOFF FLOWS EAST (OFF SITE)                                               |
| SEE PROPOSED HYDROLOGIC WORK MAP FOR FULL CALCULATION                      |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    150.00 TO NODE    400.00 IS CODE =  16
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED CONSTANT SOURCE FLOW AT NODE<<<<<
============================================================================
  USER-SPECIFIED CONSTANT SOURCE FLOW =     3.80(CFS)
  USER-SPECIFIED AREA ASSOCIATED TO SOURCE FLOW =     1.46(ACRES)
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =     3.80  AREA(AC.) =     1.46
  * SUMMED DATA: FLOW(CFS) =     8.28    TOTAL AREA(ACRES) =     4.96
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.5  TC(MIN.) =     13.58
  PEAK FLOW RATE(CFS)   =       4.48
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =       3.80  AREA(AC.) =        1.5
  * SUMMED DATA: FLOW(CFS) =       8.28    TOTAL AREA(ACRES) =        5.0
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

♀

Appendix C:
Culvert Master Input & Output

Michael Baker
INTERNATIONAL

Culvert Designer/Analyzer Report
Culvert A

Analysis Component			
Storm Event	Design	Discharge	26.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	26.00 cfs	Check Discharge	0.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	N/A ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	26.00 cfs	1,388.42 ft	14.73 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Designer/Analyzer Report
Culvert A

Component:Culvert-1

Culvert Summary					
Computed Headwater Eleva	1,388.42	ft	Discharge	26.00	cfs
Inlet Control HW Elev.	1,387.29	ft	Tailwater Elevation	N/A	ft
Outlet Control HW Elev.	1,388.42	ft	Control Type	Outlet Control	
Headwater Depth/Height	8.28				

Grades					
Upstream Invert	1,376.00	ft	Downstream Invert	1,367.00	ft
Length	68.00	ft	Constructed Slope	0.132353	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.49	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.49	ft
Velocity Downstream	14.73	ft/s	Critical Slope	0.194161	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,388.42	ft	Upstream Velocity Head	3.36	ft
Ke	0.70		Entrance Loss	2.35	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,387.29	ft	Flow Control	Submerged	
Inlet Type	Mitered to slope		Area Full	1.8	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Rating Table Report
Culvert A

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	1,376.00	1,390.00	1.00 ft

HW Elev. (ft)	Discharge (cfs)	(I) Hwi	(O) Hwo
1,376.00	0.00	1,376.00	1,376.00
1,377.00	2.50	1,377.00	1,376.98
1,378.00	7.86	1,378.00	1,377.96
1,379.00	10.82	1,379.00	1,378.49
1,380.00	13.58	1,380.00	1,379.07
1,381.00	15.87	1,381.00	1,379.64
1,382.00	17.87	1,382.00	1,380.21
1,383.00	19.67	1,383.00	1,380.78
1,384.00	21.31	1,384.00	1,381.35
1,385.00	22.84	1,385.00	1,383.87
1,386.00	24.27	1,386.00	1,385.86
1,387.00	25.06	1,386.57	1,387.00
1,388.00	25.73	1,387.08	1,388.00
1,389.00	26.38	1,387.58	1,389.00
1,390.00	27.01	1,388.08	1,390.00

Culvert Designer/Analyzer Report
Culvert B

Analysis Component			
Storm Event	Design	Discharge	26.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	26.00 cfs	Check Discharge	0.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	N/A ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	26.00 cfs	1,395.12 ft	14.73 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Designer/Analyzer Report
Culvert B

Component:Culvert-1

Culvert Summary					
Computed Headwater Eleva	1,395.12	ft	Discharge	26.00	cfs
Inlet Control HW Elev.	1,392.24	ft	Tailwater Elevation	N/A	ft
Outlet Control HW Elev.	1,395.12	ft	Control Type	Outlet Control	
Headwater Depth/Height	9.41				

Grades					
Upstream Invert	1,381.00	ft	Downstream Invert	1,376.00	ft
Length	57.00	ft	Constructed Slope	0.087719	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.49	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.49	ft
Velocity Downstream	14.73	ft/s	Critical Slope	0.194161	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,395.12	ft	Upstream Velocity Head	3.36	ft
Ke	0.70		Entrance Loss	2.35	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,392.24	ft	Flow Control	Submerged	
Inlet Type	Mitered to slope		Area Full	1.8	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Rating Table Report
Culvert B

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	1,381.00	1,397.00	1.00 ft

HW Elev. (ft)	Discharge (cfs)	(I) Hwi	(O) Hwo
1,381.00	0.00	1,381.00	1,381.00
1,382.00	2.59	1,381.97	1,382.00
1,383.00	7.96	1,383.00	1,382.97
1,384.00	10.97	1,384.00	1,383.52
1,385.00	13.70	1,385.00	1,384.10
1,386.00	15.97	1,386.00	1,384.67
1,387.00	17.96	1,387.00	1,385.24
1,388.00	19.75	1,388.00	1,387.65
1,389.00	21.01	1,388.76	1,389.00
1,390.00	21.91	1,389.33	1,390.00
1,391.00	22.76	1,389.90	1,391.00
1,392.00	23.59	1,390.47	1,392.00
1,393.00	24.39	1,391.04	1,393.00
1,394.00	25.16	1,391.60	1,394.00
1,395.00	25.91	1,392.17	1,395.00
1,396.00	26.64	1,392.74	1,396.00
1,397.00	27.35	1,393.31	1,397.00

Culvert Designer/Analyzer Report
Culvert C

Analysis Component			
Storm Event	Design	Discharge	26.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	26.00 cfs	Check Discharge	0.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	N/A ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-12 inch Circular	26.00 cfs	1,431.39 ft	33.10 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Designer/Analyzer Report
Culvert C

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev	1,431.39	ft	Discharge	26.00	cfs
Inlet Control HW Elev.	1,410.26	ft	Tailwater Elevation	N/A	ft
Outlet Control HW Elev.	1,431.39	ft	Control Type	Outlet Control	
Headwater Depth/Height	65.39				

Grades					
Upstream Invert	1,366.00	ft	Downstream Invert	1,364.00	ft
Length	40.00	ft	Constructed Slope	0.050000	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	1.00	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	1.00	ft
Velocity Downstream	33.10	ft/s	Critical Slope	1.021100	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.018	
Section Material	HDPE 12-15 inch (Corrugated Interior)		Span	1.00	ft
Section Size	12 inch		Rise	1.00	ft
Number Sections	1				

Corrugated Section Material

Outlet Control Properties					
Outlet Control HW Elev.	1,431.39	ft	Upstream Velocity Head	17.03	ft
Ke	0.50		Entrance Loss	8.52	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,410.26	ft	Flow Control	Submerged	
Inlet Type	Square edge w/headwall		Area Full	0.8	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Rating Table Report
Culvert C

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	1,366.00	1,375.00	1.00 ft

HW Elev. (ft)	Discharge (cfs)	(I) Hwi	(O) Hwo
1,366.00	0.00	1,366.00	1,366.00
1,367.00	2.06	1,366.91	1,367.00
1,368.00	4.58	1,368.00	1,367.79
1,369.00	6.04	1,369.00	1,368.38
1,370.00	7.14	1,369.94	1,370.00
1,371.00	7.82	1,370.59	1,371.00
1,372.00	8.45	1,371.25	1,372.00
1,373.00	9.03	1,371.90	1,373.00
1,374.00	9.57	1,372.56	1,374.00
1,375.00	10.09	1,373.22	1,375.00

Appendix D: Declaration of Responsible Charge

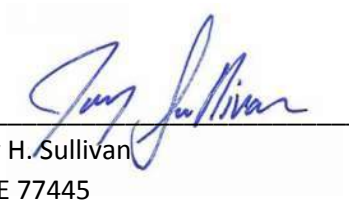
Michael Baker
INTERNATIONAL

Michael Baker
INTERNATIONAL

Declaration of Responsible Charge

I hereby declare that I am the engineer of work for this project. That I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with current standards.

I understand that the check of project drawings and specification by County of San Diego is confined to a review only and does not relieve me, as engineer of work, or my responsibilities for project design.



Jay H. Sullivan
RCE 77445
Exp. 6-30-17

9-1-15
Date